INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Imperfections present in a weld joint critically influence the reliability of the welded structure, which correspond to the failure of the component. Therefore, identification of the defects becomes essential to prevent catastrophic failures. The present investigation aims to explore the joining capability for similar ($Cu_{90}Ni_{10}$) and dissimilar (Cu-SS and SS316L-SS310) combinations of materials using arc-based joining techniques. Firstly, micro-plasma arc welding (M-PAW) of $Cu_{90}Ni_{10}$ thin sheets is established using continuous and pulse current modes. The work focuses on controlling defect formation by applying the least heat supplied. Further enhancement in joint features is attained by better control over the average heat supplied using pulse mode. Secondly, the current investigation highlights the importance of arc offset in fabricating bimetallic joints of ferrous (SS304) and non-ferrous (Cu-T2) metals using the gas tungsten arc welding (GTAW) process. The outcome of the current experimental evaluation aids in understanding the significance of arc offset and heat input in achieving a bimetallic joint with sound microstructural and mechanical properties. The present investigation also explores the M-PAW process to join a different combination of austenitic stainless steels (SS316L and SS310). It aims to establish a correlation linking the influence of heat input on the formation of different microstructural morphology, variation in joint strength, mode of failure, pore formation and to ensure weld joint remains free from internal defects, hot-cracking, and sensitization. The present work also establishes the role of solidification behaviour on solid-state phase transformation (SSPT) and its effect on the generation of compressive residual. The outcome of the current experiment suggests that a lower level of heat input allows the formation of a high amount of delta ferrite, which generates comparatively more compressive stress as a disparity in thermal expansion coefficient ($\alpha_{Ni} \sim 1.6\ \alpha_{Cr}$) and aids in the reduction of residual stress. Overall, the present work attempts to understand the solidification behaviour as well as its correlation with microstructural features and residual stress distribution for similar and dissimilar fusion welding processes.